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Yunnanilus mentibarbatus, a new species of loach from Yunnan, China (Cypriniformes, Nemacheilidae)

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Abstract

A new loach species, *Yunnanilus mentibarbatus* **sp. nov.**, is described from Yunnan Province, China. The new species differs from other congeneric species by the following combination of characters: lateral line incomplete; a pair of whisker-like fleshy projections on the chin in females; processus dentiformis present; eye diameter shorter than interorbital width; eye diameter 16.3%–23.2% of HL; 11 inner gill rakers on the first gill arch; 16 branched caudal-fin rays; head length 23.7–26.5% of standard length; caudal peduncle length 15%–17.8% of SL. Bayesian inference phylogenetic analysis based on mitochondrial COI and cytochrome b (Cyt *b*) provides strong support for the validity of *Yunnanilus mentibarbatus* **sp. nov.** Sexually dimorphic characters within *Yunnanilus*—such as dioecious coloration and specialized morphology, including tubercles on the trunk, temporal tubercles on the caudal peduncle of nuptial males, and whisker-like fleshy protuberances on the chin of females of the new species—may be related to the breeding season. Anthropogenic factors such as eutrophication of water and disappearance of aquatic plants are leading to the decline of *Yunnanilus* species. This highlights the importance of protecting the biodiversity of *Yunnanilus*.

Key Words

Mitochondrial gene, morphology, Nanpanjiang, taxonomy, *Yunnanilus*

Introduction

The genus *Yunnanilus* Nichols, 1925, belonging to the family Nemacheilidae, is a group of small freshwater fishes that inhabit slow-flowing aquatic ecosystems such as plateau streams, marshes, and lakes, with their main distribution concentrated in the Yunnan-Guizhou Plateau and Sichuan Province (Du et al. 2021). Yang and Chen (1995) divided *Yunnanilus* into the *Y. nigromaculatus* group and the *Y. pleurotaenia* group based on the presence or absence of the lateral line and cephalic lateral line. However, Kottelat (2012, 2013) questioned the monophyly of *Yunnanilus* and reassigned five species to *Heminoemacheilus* Zhu & Cao, 1987, three species to *Eonemachilus* Berg, 1938, and two species to *Micronemacheilus* Rendahl, 1944. Du et al. (2021) revealed the non-monophyly of *Yunnanilus* based on morphological characters and phylogenetic analyses, transferring most species of the *Y. nigromaculatus* group to *Eonemachilus*, reassigning *Y. jinxiensis* Zhu, Du & Chen, 2009 to *Paranemachilus* Zhu, 1983, *Y. pulcherrimus* Yang, Chen & Lan, 2004 to *Micronemacheilus*, and *Y. bailianensis* Yang, 2013 and *Y. longibarbatus* Gan, Chen & Yang, 2007 to *Heminoemacheilus*. Subsequently, Luo et al. (2023) treated *Heminoemacheilus* as a junior synonym of *Paranemachilus* Zhu, 1983, and placed *Y. retrodorsalis* Lan, Yang & Chen, 1995, into *Troglonectes* Zhang, Zhao & Tang, 2016. In the same year, Du et al. (2023)

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established the genus *Guinemachilus* Du et al., 2023, containing *Y. bailianensis* and *Y. longibarbatus*. Hence, *Yunnanilus* currently comprises 21 valid species, with 14 species distributed in the Pearl River basin (Nanpanjiang, Beipanjiang, Xijiang, and Hongshuihe), six species in the Yangtze River basin (Jinshajiang, Yalongjiang, and Tuojiang), and one species in the Red River (Lixianjiang) (Qin et al. 2024; Liu et al. 2025).

During a field survey in December 2024, 12 specimens of *Yunnanilus* were collected from a tributary of the Nanpanjiang in Yiliang County, Kunming City, Yunnan Province. Morphological examination revealed significant differences from known species of *Yunnanilus*, exhibiting distinct morphological characteristics. Further morphometric analyses and molecular phylogenetic results consistently support these specimens as representing an undescribed species, which we describe herein.

Materials and methods

All care and use of experimental animals complied with the relevant laws of the Chinese Laboratory of Animal Welfare and Ethics (GB/T 35892-2018). After anesthesia, specimens were either preserved in 95% ethanol for DNA extraction or initially fixed in a 10% formalin solution and then transferred to 75% ethanol for morphological examination and permanent preservation. Specimens were deposited in the Kunming Natural History Museum of Zoology, Kunming Institute of Zoology (**KIZ**), Chinese Academy of Sciences (**CAS**).

All meristic counts and morphometric measurements were taken on the left side of the body, and all measurements were made point to point with digital calipers following Kottelat (1990).

Genomic DNA was extracted from a small portion of the right pelvic fin clipped from alcohol-preserved specimens using a DNA extraction kit (Sangon Biotech (Shanghai) Co., Ltd., China). The primers F1 and R1 for mitochondrial cytochrome c oxidase subunit I (Ward et al. 2005) and L14724 and H15915 for cytochrome b (Xiao et al. 2001) were used for PCR amplifications. Sequencing was carried out by Sangon Biotech (Shanghai) Co., Ltd., China. All sequences were assembled in SeqMan within the DNASTAR software package and aligned in MEGA v11.0 (Tamura et al. 2021). Sequences have been submitted to GenBank (accession numbers PV707840–PV707843 for COI, PV711363–PV711366 for Cyt *b*).

Four COI and Cyt *b* gene sequences of *Yunnanilus mentibarbatus* sp. nov. were used for phylogenetic analysis together with 37 sequences of complete mitochondrial genomes, 30 Cyt *b* sequences, and 26 COI sequences downloaded from GenBank. Relevant sequence information is provided in Table 1. *Parabotia fasciata* Dabry de Thiersant, 1872, and *Leptobotia elongata* Bleeker, 1870, were selected as the outgroup. The phylogenetic position of *Yunnanilus mentibarbatus* sp. nov. was determined by maximum likelihood (ML) and Bayesian inference (BI) methods, which were implemented in the CIPRES Science Gateway (Miller et al. 2010). The ML tree was constructed in RAxML-HPC v8 (Stamatakis 2014) using the rapid bootstrapping configuration with 1000 bootstrap iterations. The optimal nucleotide substitution model for the concatenated dataset (COI + Cyt *b*) was determined under the AICc criterion using PartitionFinder v2.0 and identified as GTR+I+G. The BI tree was generated in MrBayes in XSEDE v3.2.7a (Ronquist et al. 2012). Two runs were performed simultaneously with four Markov chains starting from a random tree. The chains were run for 7 million generations and sampled every 1000 generations. The first 25% of sampled trees were discarded as burn-in, and the remaining trees were used to create a consensus tree and estimate Bayesian posterior probabilities (BPPs). The constructed phylogenetic trees were viewed and edited in FigTree v1.4.4 (Rambaut 2009).

Nomenclatural acts registration

The electronic version of this article in portable document format represents a published work according to the International Commission on Zoological Nomenclature (ICZN); hence, the new name contained in the electronic version is effectively published under the Code from the electronic edition alone (see Articles 8.5–8.6 of the Code). This published work and the nomenclatural acts it contains have been registered in ZooBank LSIDs (Life Science Identifiers) and can be resolved, and the associated information can be viewed through any standard web browser by appending the LSID to the prefix http://zoobank.org/.

Results

***Yunnanilus mentibarbatus* sp. nov.**

https://zoobank.org/E8DC7148-A271-4878-B7A0-2EE9EA2FCEDE

Type materials. ***Holotype.*** • KIZ2024010565, female, 68.3 mm standard length (SL), Jiuxiang Village, Yiliang County, Kunming City, Yunnan Province, P.R. China; a stream within the Nanpanjiang River basin; 24.8849°N, 103.1672°E; M.Q. Duan collected in December 2024.

Paratypes. • Five specimens. KIZ2024010566–570, female, 40.3–54.2 mm SL; same as holotype.

Other materials. • DLN20240615–620, 35.5–48.9 mm SL, preserved in 99% ethanol for molecular analysis, same as type specimens.

Etymology. The specific name *mentibarbatus* is derived from the Latin words *mentum* (chin) and *barbatus* (bearded or barbels), in reference to the unique short barbel on the mentum in female (Fig. 1D). Gender: Masculine. We suggest the Chinese vernacular name "颏须云南鳅" and the English vernacular name "mentum barbel Yunnan loach."

Table 1. Sequence information of *Yunnanilus* species used in Fig. 4.

Sample ID	Species	Collection Locality	Gene	
			COI GenBank No.	Cyt *b* GenBank No.
DLN20240616	*Yunnanilus mentibarbatus* sp. nov.	Yiliang County, Kunming City, Yunnan Province, China.	PV707840	PV711363
DLN20240617	*Yunnanilus mentibarbatus* sp. nov.	Yiliang County, Kunming City, Yunnan Province, China.	PV707841	PV711364
DLN20240618	*Yunnanilus mentibarbatus* sp. nov.	Yiliang County, Kunming City, Yunnan Province, China.	PV707842	PV711365
DLN20240620	*Yunnanilus mentibarbatus* sp. nov.	Yiliang County, Kunming City, Yunnan Province, China.	PV707843	PV711366
DLN20230180	*Yunnanilus polylepis*	Dalongtan, Huaning Country, Yuxi City, Yunnan, China.	PP254216	PP262976
DLN20230181	*Yunnanilus polylepis*	Dalongtan, Huaning Country, Yuxi City, Yunnan, China.	PP254217	PP262977
DLN20230182	*Yunnanilus polylepis*	Dalongtan, Huaning Country, Yuxi City, Yunnan, China.	PP254218	PP262978
DLN20230183	*Yunnanilus polylepis*	Dalongtan, Huaning Country, Yuxi City, Yunnan, China.	PP254219	PP262979
DLN20230184	*Yunnanilus polylepis*	Dalongtan, Huaning Country, Yuxi City, Yunnan, China.	PP254220	PP262980
DLN20230191	*Yunnanilus pleurotaenia*	Longtan Village, Jianghua Road, Jiangchuan District, Yuxi City, Yunnan, China.	PP254221	PP262981
DLN20230192	*Yunnanilus pleurotaenia*	Longtan Village, Jianghua Road, Jiangchuan District, Yuxi City, Yunnan, China.	PP254222	PP262982
DLN20230193	*Yunnanilus pleurotaenia*	Longtan Village, Jianghua Road, Jiangchuan District, Yuxi City, Yunnan, China.	PP254223	PP262983
DLN20230194	*Yunnanilus pleurotaenia*	Longtan Village, Jianghua Road, Jiangchuan District, Yuxi City, Yunnan, China.	PP254224	PP262984
DLN20230195	*Yunnanilus pleurotaenia*	Xilongtan, Xipu Park, Chengjiang City, Yuxi, Yunnan, China.	PP254225	PP262985
DLN20230196	*Yunnanilus pleurotaenia*	Xilongtan, Xipu Park, Chengjiang City, Yuxi, Yunnan, China.	PP254226	PP262986
DLN20230197	*Yunnanilus pleurotaenia*	Xilongtan, Xipu Park, Chengjiang City, Yuxi, Yunnan, China.	PP254227	PP262987
DLN20230198	*Yunnanilus pleurotaenia*	Xilongtan, Xipu Park, Chengjiang City, Yuxi, Yunnan, China.	PP254228	PP262988
DLN20230199	*Yunnanilus pleurotaenia*	Xilongtan, Xipu Park, Chengjiang City, Yuxi, Yunnan, China.	PP254229	PP2692989
DLN20230200	*Yunnanilus pleurotaenia*	Bai-zhai Tiaoyu Stream, Jianghua Highway, Jiangchuan District, Yuxi, Yunnan, China.	PP254230	PP262990
DLN20230201	*Yunnanilus pleurotaenia*	Bai-zhai Tiaoyu Stream, Jianghua Highway, Jiangchuan District, Yuxi, Yunnan, China.	PP254231	PP262991
DLN20230202	*Yunnanilus pleurotaenia*	Bai-zhai Tiaoyu Stream, Jianghua Highway, Jiangchuan District, Yuxi, Yunnan, China.	PP254232	PP262992
DLN20230203	*Yunnanilus pleurotaenia*	Bai-zhai Tiaoyu Stream, Jianghua Highway, Jiangchuan District, Yuxi, Yunnan, China.	PP254233	PP262993
DLN20230205	*Yunnanilus pleurotaenia*	Bai-zhai Tiaoyu Stream, Jianghua Highway, Jiangchuan District, Yuxi, Yunnan, China.	PP254234	PP262994
DLN20230206	*Yunnanilus pleurotaenia*	Bai-zhai Tiaoyu Stream, Jianghua Highway, Jiangchuan District, Yuxi, Yunnan, China.	PP254235	PP262995
DLN20230207	*Yunnanilus pleurotaenia*	Bai-zhai Tiaoyu Stream, Jianghua Highway, Jiangchuan District, Yuxi, Yunnan, China.	/	PP262996
CB83	*Yunnanilus triangulus*	Dalongtan Spring, Wangma Village, Huaning County, Yuxi City, Yunnan, China.	PQ300642	PQ306053
CB84	*Yunnanilus triangulus*	Dalongtan Spring, Wangma Village, Huaning County, Yuxi City, Yunnan, China.	PQ300643	PQ306054
CB85	*Yunnanilus triangulus*	Dalongtan Spring, Wangma Village, Huaning County, Yuxi City, Yunnan, China.	PQ300644	PQ306055
CB86	*Yunnanilus triangulus*	Dalongtan Spring, Wangma Village, Huaning County, Yuxi City, Yunnan, China.	PQ300645	PQ306056
CB87	*Yunnanilus triangulus*	Dalongtan Spring, Wangma Village, Huaning County, Yuxi City, Yunnan, China.	PQ300646	PQ306057

Diagnosis. Comparative data between *Yunnanilus mentibarbatus* sp. nov. and all known species within the genus *Yunnanilus* are provided in Table 2. The new species can be distinguished from congeneric species of *Yunnanilus* by the unique character, a pair of short barbels on the mentum in female. In addition, the new species can be further distinguished from other species of *Yunnanilus* by the following characters: whole body covered by scales; lateral line incomplete, with 16–21 pores; processus dentiformis present (Fig. 1C); eye diameter shorter than interorbital width; 10–11 branched pectoral-fin rays; six branched pelvic-fin rays; six branched anal-fin rays; 16 branched caudal-fin rays; 11 inner gill rakers on first gill arch.

Description. All morphometric and meristic data are given in Table 3. Body covered by dense scale; deepest body depth 15.6–20.5% of SL located anterior to dorsal fin origin, decreasing from dorsal-fin origin to caudal-fin base (Fig. 2). Head length greater than its depth, head length 23.7–26.5% of SL. Snout slightly blunt, shorter than postorbital length of head. Processus dentiformis present. Mouth inferior, middle of lower lip with notch, both lips have tangible wrinkles. Eyes normal, eye diameter 16.3–23.2% of head length (HL), smaller than interorbital width. Anterior and posterior nostrils separated by a short distance, posterior nostril closer to anterior margin of eye than to tip of snout, base of anterior nostril tube-shaped, without barbel-like tip, anterior nostril length 8.1–12.1% of eye diameter.

Possessing a pair of short barbels on the mentum in female. Three pairs of barbels, two rostral pairs and one maxillary pair; inner rostral barbel length 25.1–33.6% of HL; outer rostral barbel length 29.9–38.8% of HL, reaching posterior nostril; maxillary barbel length 31.8–41.7% of HL, reaching posterior margin of opercula.

Dorsal fin with four unbranched and eight branched rays; dorsal-fin origin anterior to pelvic-fin origin; pectoral fin with one unbranched and 10–11 branched rays, inserted immediately anterior to vertical through posterior point of operculum; pelvic fin with one unbranched and six branched rays, tips of pelvic fin not reaching anus; anal fin with three unbranched and six branched rays, length between tip of anal fin and anus origin 52.7–95.1% of eye diameter; caudal fin emarginate, with 16 branched rays. Lateral line incomplete, with 16–21 pores, reaching tip of

Table 2. *Yunnanilus* species and comparison of identifying characteristics between the new species and its congeners.

Species	Scale	Dorsal-fin branched rays	Pectoral-fin branched rays	Pelvic-fin branched rays	Anal-fin branched rays	Caudal-fin branched rays	Processus dentiformis	Eye diameter vs. interorbital width	Inner gill rakers	Lateral line pores
Y. mentibarbatus sp. nov.	Whole body	8–9	10	7	6–7	16	Present	Less than	11	16–21
Y. analis	Absent	9	12	7	6	15	Present	Greater than	8	12–15
Y. beipanjiangensis	Absent	8–9	11	7	5	16	Present	Greater than	10	6–12
Y. chuanheensis	Whole body	8–9	11–12	7–8	5–6	16	Absent	Less than	10–11	Unknown
Y. chui	Absent	9	11	8	6	16	Present	Greater than	12	4
Y. discoloris	Absent	8–9	11–12	7	5	16	Absent	Equal to	8–10	4–10
Y. elakatis	Caudal peduncle	9–10	10–11	7–8	5–6	16	Present	Less than	10–12	Unknown
Y. forkicaudal	Absent	7	9–11	8	5	16	Unknown	Less than	12	Unknown
Y. longibulla	Whole body	8	11	7–8	5	15–17	Present	Greater than	10–12	11–17
Y. jiuchiensis	Whole body	8	11	7	6	16	Absent	Greater than	8	6–11
Y. macrogaster	Whole body	8	12–13	7	5	16	Present	Less than	13	12–13
Y. macrolepis	Whole body	8–9	10–11	6	6	15–16	Present	Less than	14–15	9–17
Y. macrositanus	Caudal peduncle	7	11	8	5	16–17	Unknown	Less than	8	Unknown
Y. nanpanjiangensis	Caudal peduncle	8–9	10	6–7	6	16	Present	Less than	10	6–10
Y. paludosus	Absent	8	9–11	6–7	5–6	14–16	Present	Less than	12	19–21
Y. parvus	Whole body	8	10–11	7	5	16	Present	Less than	8–9	7–16
Y. pleurotaenia	Whole body	8	10	6	5	15–16	Present	Less than	10–13	16–25
Y. polylepis	Whole body	9	10–11	6	5	15–16	Absent	Less than	10	Unknown
Y. sichuanensis	Posterior body	8	12	7	5	16	Absent	Less than	9–10	16–17
Y. spanisbripes	Whole body	9	11	7	6	16	Present	Less than	11–12	15–24
Y. triangulus	Whole body	8	10–11	6	5	15–17	Absent	Less than	9–11	Unknown
Y. yangi	Absent	8	11	6–7	5	16	Absent	Less than	Unknown	Unknown

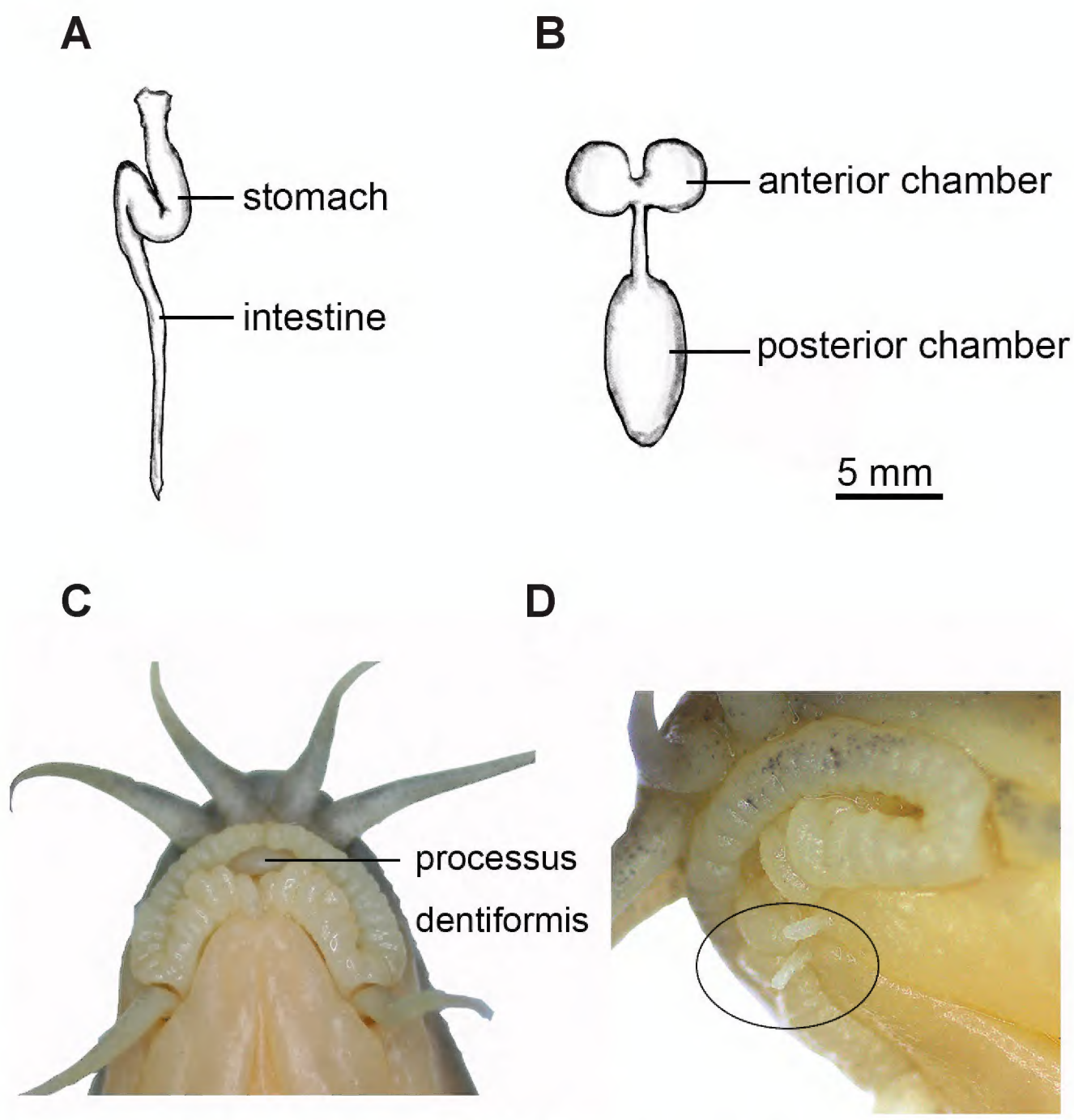

Figure 1. Stomach and intestine (**A**), air bladder (**B**), processus dentiformis absent (**C**) in *Yunnanilus mentibarbatus* sp. nov., holotype KIZ2024010565, and a pair of short barbels on the mentum (**D**) in paratype KIZ2024010566.

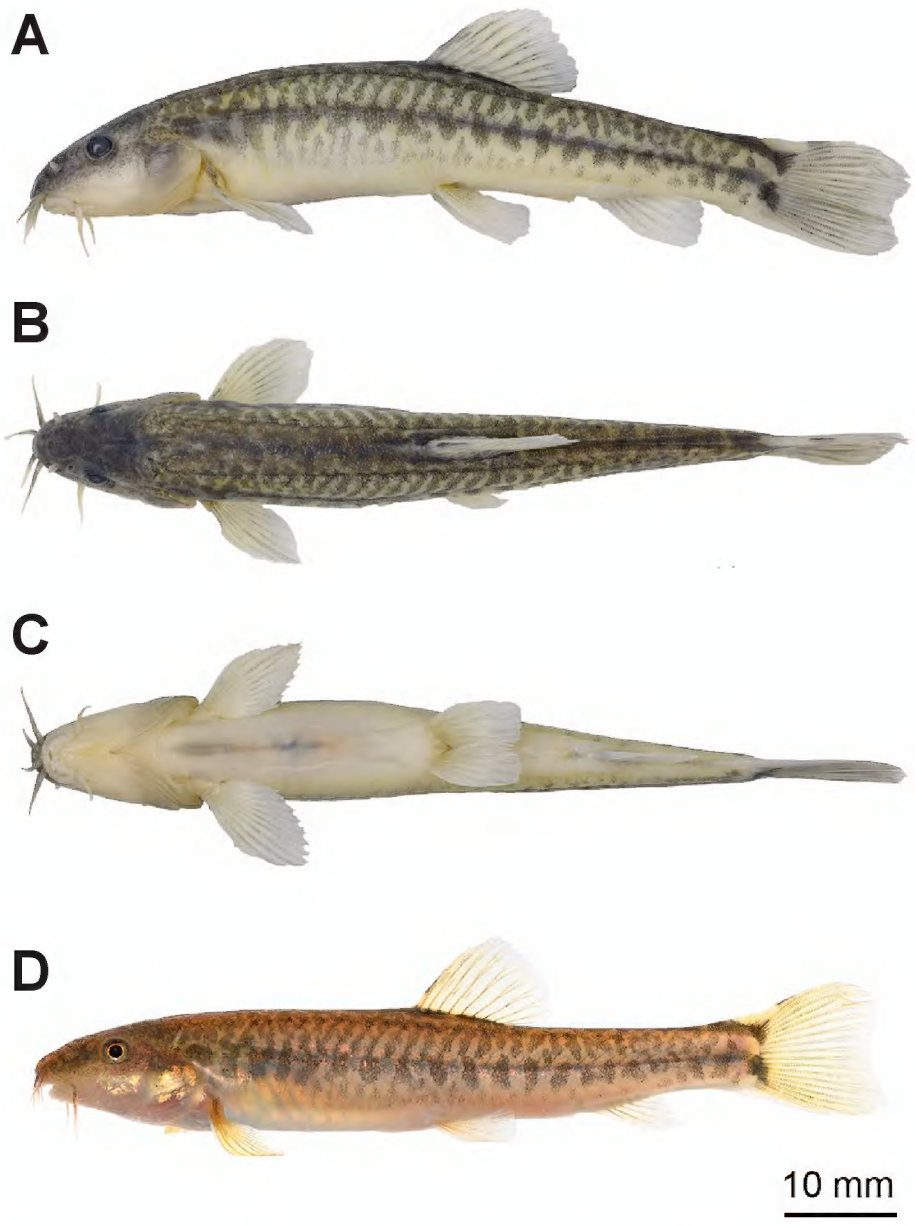

Figure 2. Morphometric characters of *Yunnanilus mentibarbatus* sp. nov. **A–D.** Lateral, dorsal, and ventral views and a living photo of the holotype KIZ2024010565.

Table 3. Morphometric and meristic data of *Yunnanilus mentibarbatus* sp. nov.

Characters	Holotype	Paratypes (Mean±SD)
Total length (mm)	81.2	50.4–65.8 (48.6±6.6)
Standard length (mm)	68.3	40.3–54.2 (45.4±5.6)
Percent of standard length (%)		
Deepest body depth	18.0	15.6–20.5 (18.2±1.5)
Head width	13.8	12.2–15.4 (13.9±1.0)
Predorsal length	52.3	50.7–53.9 (52.8±0.9)
Prepelvic length	53.6	53.3–58.9 (55.2±1.5)
Preanal length	76.2	75.2–79.7 (77.6±1.3)
Preanus length	70.5	70.5–75.9 (72.8±1.5)
Caudal-peduncle length	15.4	15.0–17.8 (15.9±0.9)
Caudal-peduncle depth	9.9	8.9–11.4 (10.3±0.7)
Percent of head length (%)		
Head width	57.4	50.7–58.2 (55.0±2.7)
Head depth	58.1	49.7–58.1 (54.3±2.9)
Eye diameter	16.3	16.3–23.2 (20.0±2.2)
Interorbital width	31.2	26.3–34.2 (30.6±2.5)
Snout length	32.3	30.4–36.6 (33.6±1.9)
Percent of caudal-peduncle length (%)		
Caudal-peduncle depth	64.0	49.9–75.5 (65.2±6.4)
Counts		
Dorsal-fin rays	iv, 8	iv, 8
Pectoral-fin rays	i, 11	i, 10
Pelvic-fin rays	i, 6	i, 6
Anal-fin rays	iii, 6	iii, 6
Branched caudal-fin rays	16	16

pectoral fin and anterior to dorsal fin origin; 11 inner gill rakers on first gill arch (in three specimens). Cephalic lateral system with 11–13+4–5 infraorbital canal pores, 7–8 supraorbital canal pores, 6 supratemporal canal pores, and 11 preoperculomandibular canal pores.

Stomach U-shaped (Fig. 1A), intestine long and straight. Swim bladder divided into two chambers and connected by a slender tube, tube length about 1/2 of posterior chamber length; anterior chamber covered by dumbbell-shaped bony capsule, posterior chamber developed (Fig. 1B).

Coloration. In life, females have a light golden yellow head and trunk (Fig. 2D). Ventral head and abdomen surface without color pattern, 19–24 large brown blotches irregularly distributed on dorsal and lateral body, connected or unconnected to longitudinal black stripe on lateral line. Two irregular spots on caudal fin base, gills, and below margin of eyes with shimmering gold color. Fin membrane hyaline. In formalin-fixed specimens, body is faded and off-white with dark gray spots on the body surface (Fig. 2A).

Distribution and habitat. *Yunnanilus mentibarbatus* sp. nov. is currently known only from a stream of the Nanpanjiang River in Jiuxiang Village, Yiliang County, Kunming City, Yunnan Province, China (Fig. 3A). The species inhabits deep pools in caves and streams outside caves at depths ranging from 0.5 to 3 meters (Fig. 3A). New species distribution spans both within the cave and the adjacent surface streams outside the cave. The stream's flow is slow, and there are water plants in the stream outside the cave. Females are in reproductive season, gonadal stage 2–3, with small spawns in the abdominal cavity. Absence of fleshy projections at the genitalia of females, the fact that only females are harvested, and associated decrease in the number of males during the reproductive season. Other species present in the streamlet include *Pseudorasbora parva*, *Rhinogobius giurinus*, *Rhodeus ocellatus*, and *Schistura fasciolata*.

Genetic comparisons. The BI and ML trees exhibit similar topologies, with the numbers above the branch representing Bayesian posterior probabilities from BI and bootstrap support values from ML, respectively. Within *Yunnanilus*, the species are broadly divided into two clades: *Eonemachilus* and *Y. yangi* He et al. 2024, form one clade, while the new species clusters with other analyzed *Yunnanilus* species in a separate clade. In addition, *Yunnanilus mentibarbatus* sp. nov. forms a sister group to *Y. jiuchiensis* Du, Hou, Chen & Yang, 2018 (Fig. 4). The uncorrected *p*-distances of the COI and Cyt *b* genes between *Yunnanilus mentibarbatus* sp. nov. and the other seven species ranged from 8.40% to 11.71%. The maximum and minimum uncorrected *p*-distances were found between *Y. mentibarbatus* sp. nov. and *Y. yangi* (11.71%) and between *Y. analis* Yang, 1990, and *Y. pleurotaenia* Regan, 1904 (0.41%), respectively (Table 4).

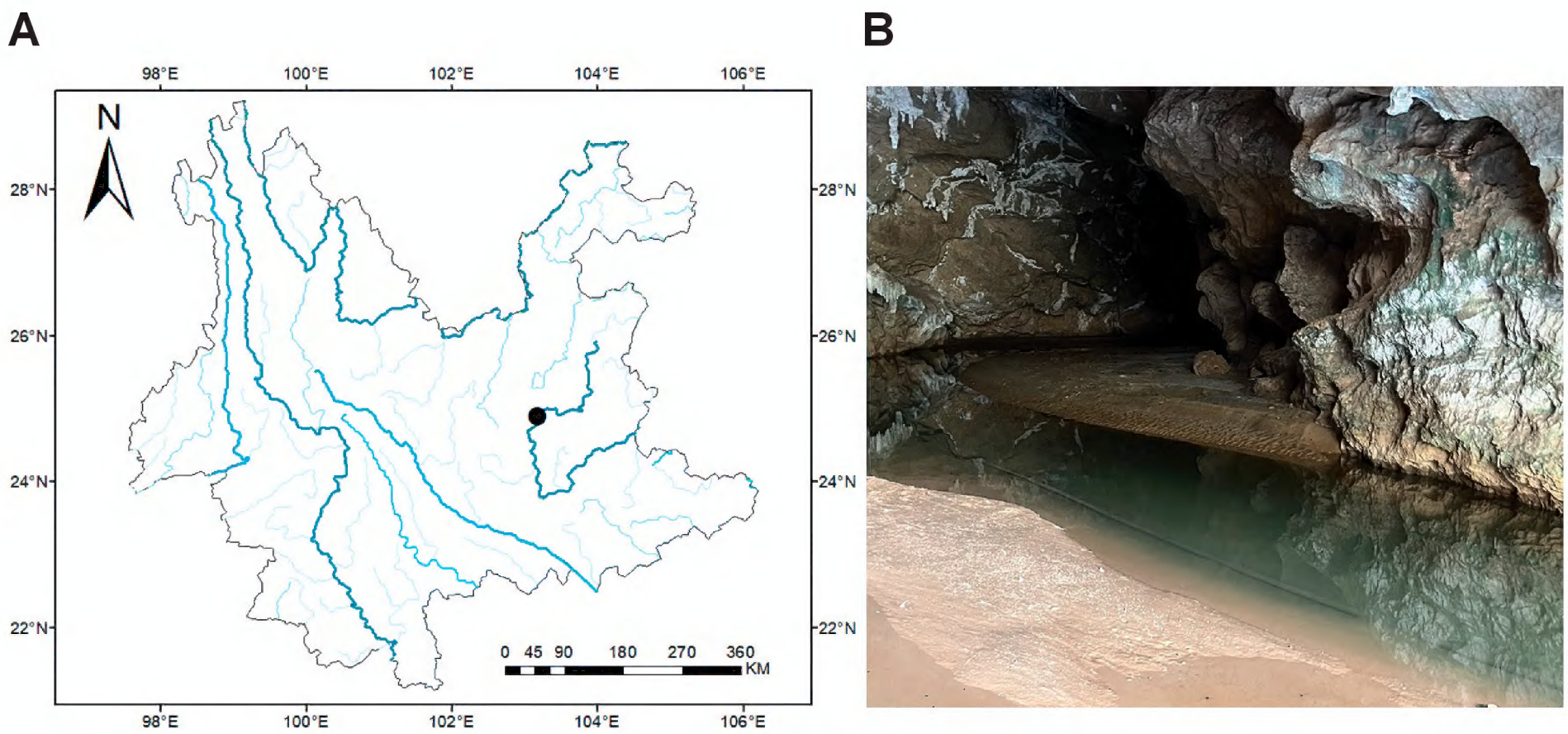

Figure 3. Type locality of *Yunnanilus mentibarbatus* sp. nov., distribution map (**A**). Habitat photo of type locality at time of collection (**B**).

Table 4. Uncorrected *p*-distances (%) between eight species in the genus *Yunnanilus* based on mitochondrial COI and Cyt *b* genes.

		1	2	3	4	5	6	7
1	*Y. pleurotaenia*							
2	*Y. analis*	0.41						
3	*Y. jiuchiensis*	2.23	2.43					
4	*Y. chuanheensis*	1.44	1.57	2.22				
5	*Y. yangi*	7.75	7.77	7.66	7.91			
6	*Y. polylepis*	5.07	4.97	4.86	5.66	9.82		
7	*Y. triangulus*	1.66	1.68	2.21	1.68	7.65	5.19	
8	*Y. mentibarbatus*	8.91	9.04	8.58	8.75	11.71	9.18	8.40

Comparative materials

All specimens for comparison are as follows:

Y. analis: KIZ 1960000625–26, 2 ex., 37.7–50.2 mm SL, Xingyun Lake, Yuxi City, Yunnan, China.

Y. beipanjiangensis: 91007016, holotype, 47.6 mm SL, 91007017, paratypes, 1 ex., 46.1 mm SL, 91007001–09, 9 ex., 40.5–73.2 mm SL, Luoshuidong, Xintun, Zhanyi District, Yunnan, China.

Y. chui: KIZ 1989001596, paratypes, 1 ex., 36.1 mm SL, Fuxian Lake, Yuxi, Yunnan, China.

Y. discoloris: KIZ 1983000938–42, 5 ex., 24.0–32.9 mm SL, Bailongtan, Chenggong District, Kunming, Yunnan, China.

Y. longibulla: KIZ 1981002383, holotype, 40.9 mm SL, KIZ 1981002384–86, KIZ 1981002388–93, paratypes, 9 ex., 28.5–40.9 mm SL, Yongsheng, Lijiang, Yunnan Province, China.

Y. jiuchiensis: KIZ 2018000002, holotype, 35.3 mm SL, KIZ 2018000001, KIZ 2018000003–09, paratypes, 8 ex., 29.5–37.4 mm SL, Jiuchi County, Pengzhou City, Sichuan Province, China.

Y. macrogaster: KIZ 1980004273, holotype, 70.1 mm SL, KIZ 1980004274, paratypes, 1 ex., 70.0 mm SL, Luoping County, Yunnan, China.

Y. macrolepis: 9509001, 9509003, 9506997, paratypes, 3 ex., 63.1–83.8 mm SL, Luoping County, Yunnan, China.

Y. nanpanjiangensis: 9191108, 9191113–14, 191122, 191129, 191134, paratypes, 6 ex., 50.5–67.3 mm SL, Luoping County, Yunnan, China.

Y. paludosus: KIZ 1980001277–81, paratypes, 5 ex., 56.7–74.3 mm SL, Luoping County, Yunnan, China.

Y. parvus: KIZ 1984001244, KIZ 1984001246, KIZ 1984001248, KIZ 1984001251–53, paratypes, 7 ex., 25.0–33.5 mm SL, Nanjian, Kaiyuan City, Yunnan, China.

Y. pleurotaenia: KIZ 2000400050, KIZ 2000400053–54, KIZ 2000400061, KIZ 2000400063, KIZ 2000400069, KIZ 2000400071–72, KIZ 2000400074, 9 ex., 41.8–63.3 mm SL, Qinglongtan, Dabanqiao, Kunming City, Yunnan Province, China. KIZ 2007003946, 1 ex., 54.9 mm SL, Baiyukou, Dianchi Lake, Kunming City, Yunnan Province, China.

Y. polylepis: KIZ 2023000009, holotype, 43.7 mm SL, KIZ2023000010–14, KIZ2023000039–40, paratypes, 7 ex., 31.9–37.1 mm SL, Qixitan Park, Panxi Town, Huaning County, Yuxi City, Yunnan, China.

Y. spanisbripes: KIZ 199504007, KIZ 199309023, KIZ 19920703001–7, KIZ 200306011, 10 ex., 51.2–71.9 mm SL, Niulanjiang, Deze Township, Zhanyi District, Qujing, Yunnan, China.

Y. triangulus: KIZ2018002410, holotype, 51.8 mm SL, KIZ2018002404–09, 2411, paratypes, 7 ex., 37.1–54.6 mm SL, Dalongtan Spring, Wangma Village, Huaning County, Yuxi City, Yunnan, China.

Other characteristic information about *Y. chuanheensis*, *Y. elakatis*, *Y. forkicaudalis*, *Y. macrositanus*, *Y. sichuanensis*, and *Y. yangi* was obtained from their original descriptions.

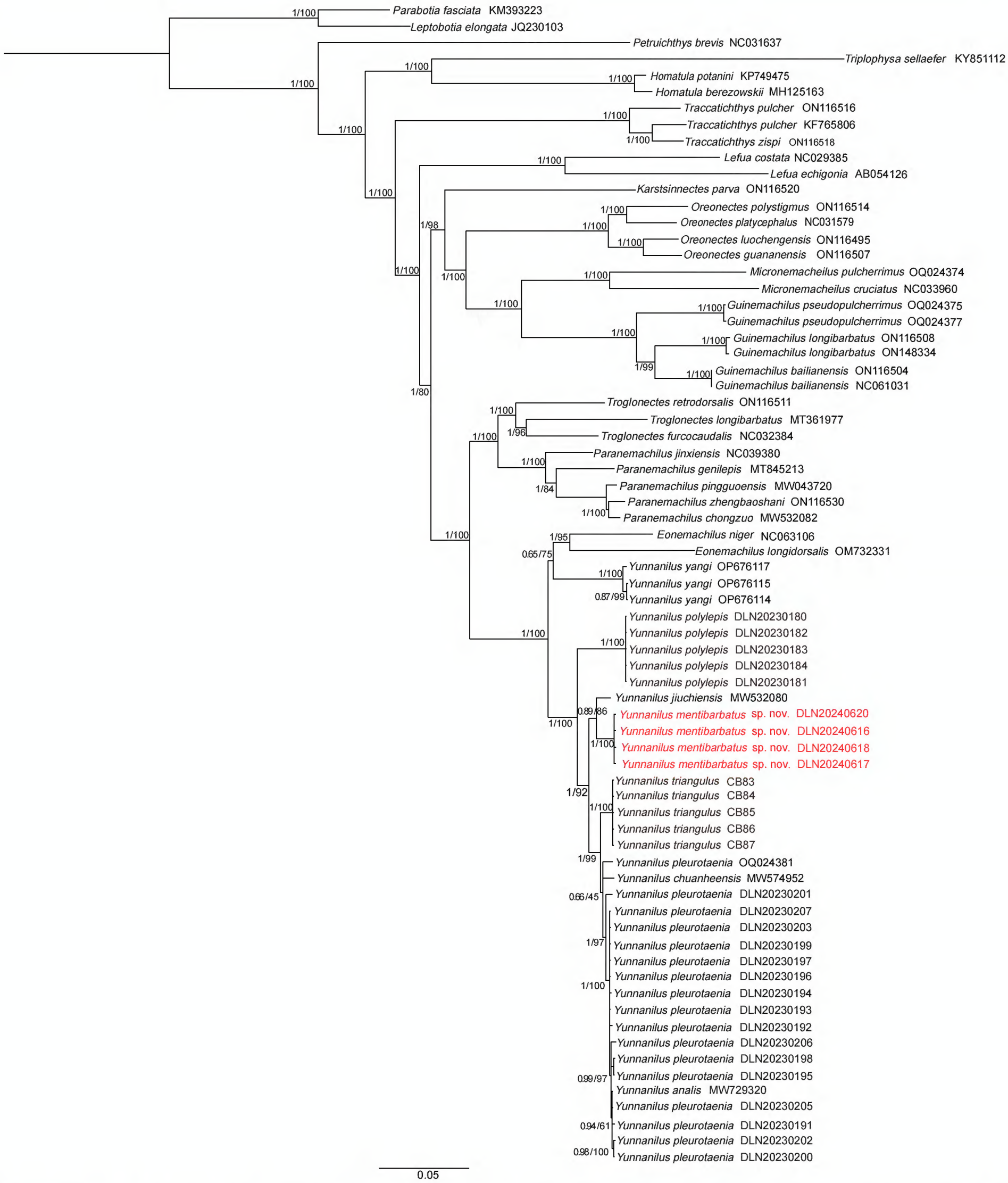

Figure 4. Bayesian phylogram of *Yunnanilus* based on a concatenated dataset of mitochondrial cytochrome c oxidase subunit I (COI) and cytochrome *b* (Cyt *b*) sequences. The numbers on the branches represent BPPs from BI and bootstrap supports from ML.

Discussion

Molecular analysis unequivocally placed *Yunnanilus mentibarbatus* sp. nov. within the genus *Yunnanilus*. Diagnostic characters of the genus *Yunnanilus* include an inferior mouth; anterior and posterior nostrils slightly separated (distance greater than 2/5 of eye diameter); anterior nostril tube-like, without elongated barbel-like structure; cheek scaleless; lips smooth with furrows; and lateral line and cephalic lateral-line pores present (Kottelat and Chu 1988; Du et al. 2023; Qin et al. 2024). These morphological features, characteristic of the genus, further confirm that the new species belongs to *Yunnanilus*. Specimen collection was hindered because the new species inhabits deep pools in caves, and seasonal constraints prevented access, so male specimens are unavailable. Hence, the short barbels on the chin of female specimens cannot be regarded as a stable diagnostic character. However, the

species can be distinguished from all congeners by the following combination of characters.

To date, 22 species of *Yunnanilus* have been described, including the new species. Within the genus, *Y. mentibarbatus* sp. nov., *Y. analis*, and *Y. beipanjiangensis* Li, Mao & Sun, 1994, *Y. chui* Yang, 1991, *Y. elakatis* Cao & Zhu, 1989, *Y. longibulla* Yang, 1990, *Y. macrogaster* Kottelat & Chu, 1988, *Y. macrolepis* Li, Tao & Mao, 2000, *Y. nanpanjiangensis* Li, Tao & Lu, 1994, *Y. paludosus* Kottelat & Chu, 1988, *Y. parvus* Kottelat & Chu, 1988, *Y. pleurotaenia*, and *Y. spanisbripes* An, Liu & Li, 2009 are characterized by the presence of a processus dentiformis. In contrast, *Y. chuanheensis* Jiang, Zhao, Du & Wang, 2021; *Y. discoloris* Zhou & He, 1989; *Y. jiuchiensis*; *Y. polylepis* Qin, Shao, Du & Wang; *Y. sichuanensis* Ding, 1995; *Y. triangulus* Liu, Lyu, Du & Chen, 2025; and *Y. yangi* lack a processus dentiformis (*Y. forkicaudalis* Li, 1999 and *Y. macrositanus* Li, 1999 unknown). Therefore, *Y. mentibarbatus* sp. nov. (processus dentiformis present) can be easily distinguished from congeners without a processus dentiformis, with the exception of *Y. forkicaudalis* and *Y. macrositanus*.

Furthermore, *Y. mentibarbatus* sp. nov. can be distinguished from those species that also possess a processus dentiformis based on the presence and distribution of body scales. *Y. mentibarbatus* sp. nov. differs from *Y. analis*, *Y. beipanjiangensis*, *Y. chui*, *Y. forkicaudalis*, and *Y. paludosus* in having the entire body densely covered with scales (vs. scales absent), and from *Y. elakatis*, *Y. macrositanus*, and *Y. nanpanjiangensis* by having scales on the entire body (vs. scales restricted to the caudal peduncle). Therefore, *Y. mentibarbatus* sp. nov., characterized by both the presence of a processus dentiformis and full body coverage with scales, can be easily distinguished from all other congeners, which either lack a processus dentiformis, lack scales, or both.

Yunnanilus mentibarbatus sp. nov. can also be distinguished from *Y. longibulla* by having an eye diameter shorter than interorbital width (vs. larger), eye diameter 16.3%–23.2% of HL (vs. 23.9%–31.9%), and interorbital width 26.3%–34.2% of HL (vs. 16.8%–23.2%); from *Y. macrolepis* by having 11 inner gill rakers on the first gill arch (vs. 14–15), predorsal length 50.7%–53.9% of SL (vs. 55.4%–58.2%), and caudal peduncle length 15%–17.8% of SL (vs. 10.8%–12.4%); from *Y. macrogaster*, *Y. parvus*, and *Y. pleurotaenia* by having 11 inner gill rakers on the first gill arch (vs. 8–9 in *Y. parvus*, 13 in *Y. macrogaster*), 16–21 lateral-line pores (vs. 12–13 in *Y. macrogaster*), body depth 15.6%–20.5% of SL (vs. 22.3%–22.5% in *Y. macrogaster*, 20.6%–23.1% in *Y. parvus*), caudal peduncle length 15%–17.8% of SL (vs. 12.7%–12.8% in *Y. macrogaster*, 10.7%–13.3% in *Y. parvus*, 11.1%–13.4% in *Y. pleurotaenia*), and caudal peduncle depth 49.9%–75.5% of caudal peduncle length (vs. 88.3%–102.9% in *Y. parvus*, 75.7%–96.2% in *Y. pleurotaenia*); and from *Y. spanisbripes* by having caudal peduncle length 15%–17.8% of SL (vs. 11.2%–13.8% in *Y. spanisbripes*).

Although color pattern variation is a common sexual dimorphism in the genus *Yunnanilus*, tubercles have been observed in *Y. chuanheensis*, *Y. polylepis*, and *Y. triangulus* (Jiang et al. 2021; Qin et al. 2024; Liu et al. 2025). The breeding season of *Yunnanilus* may extend from October to the following April because ova developed to stage three or four were found in *Y. yangi* (collected in October) and *Y. pleurotaenia* (collected in December), and stage four or five in *Y. jiuchiensis* (collected in March) and *Y. triangulus* (collected in April). The new species, *Y. mentibarbatus* sp. nov., was collected during the breeding season, and female eggs had developed to stage two or three. Hence, the whisker-like fleshy projections on the chin of females may be related to breeding. Regrettably, male specimens remain unavailable. Future efforts will be intensified to investigate *Yunnanilus* species, with continued fieldwork aimed at securing male specimens for subsequent supplementation.

Fishes within *Yunnanilus* inhabit narrow habitats and are sensitive to environmental changes. Recently, within the genus *Yunnanilus*, *Y. analis*, *Y. chui*, *Y. discoloris*, *Y. elakatis*, and *Y. macrositanus* have been classified as endangered due to environmental impacts that have reduced their numbers (IUCN 2025). Lin et al. (2023) found that the Nanpanjiang (Yunnan section) failed to meet target water quality standards in several areas, primarily due to excess total phosphorus in the basin. In conclusion, anthropogenic factors such as eutrophication and the disappearance of aquatic plants are causing the decline of *Yunnanilus*. The limited distribution of *Yunnanilus* and their specific water quality requirements underscore the importance of environmental protection to preserve their biodiversity.

Competing interests

The authors declare that they have no competing interests.

Authors' Contributions

Z.-N. C. and L.-N. D. measured the specimens, analyzed the data, conceived and designed the study, and prepared the manuscript. Y. L. provided funding. All authors read and approved the final version of the manuscript.

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